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# USES OF WOOD WASTES IN PULP AND PAPER PRODUCTS

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Wood waste from logging and the manufacture of wood products often presents a problem of disposal. Since the quantities produced in single operations are frequently too small to consider developing a new pulping operation, a logical procedure in such cases is to investigate the possibilities of supplying the material to pulp and paper mills that may be operating in the area.

Wood waste in the form of slabs, edgings, trim, chips, shavings, and veneer-mill waste as produced in various woodworking operations, is acceptable to many mills.[2] This type of waste is likely to be more acceptable if it is prepared or processed to a uniform size or graded into different sizes. Shipping distance is also an important factor in determining the acceptability of a waste wood material. Methods of handling, bundling, baling, and the like, must be considered with the view to reducing transportation and handling costs.

The types of products in which wood wastes are being utilized at present are chemical, semichemical, and groundwood pulps, and coarsely fiberized wood, all of which are used in the manufacture of various kinds of paper, roofing and saturating felt, container board, insulating board, and hardboard.

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## Chemical Pulp

Although wood wastes frequently produce pulps inferior to those made from round wood, they may offer an important source of raw material to supplement the wood supply of a pulpmill. This waste will generally include species less desirable for pulping and will come to the mill in various forms such as slabs, edgings, trims, chips, shavings, and veneer cores from plywood plants. Some of the waste material can undergo routine barking and chipping and be

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[1] Maintained at Madison, Wis., in cooperation with the University of Wisconsin.

[2] Various uses of these wood wastes are described in Forest Products Laboratory Reports Nos. R1666-1, "Uses for Sawdust and Shavings" and R1666-2, "Uses for Slabs, Edgings, and Trims."

used along with the regular supply of pulpwood chips. It may be necessary, however, to subject material that is difficult to bark and chip to a separate digestion under conditions adjusted to the material at hand.

A waste material available in the pulpmill itself is a residue of coarse sawdust and pin chips from the slashing and chipping operations. This material has received only limited consideration because it is dirty and contains only short fibers. Although the fiber loss in operations subsequent to pulping may be high, low-quality pulp can be obtained from sawdust.[3] It appears advisable, however, to mix sawdust with at least 25 percent of ordinary-sized chips for satisfactory operation. Experiments at the Forest Products Laboratory and elsewhere have shown that the pulp from sawdust is strong enough to be used in mill wrap and low-grade board.

Soda pulp is being produced from both hardwood and softwood veneer-mill waste. Veneer trim is passed through special chippers, usually at the veneer mill, and is sold to pulpmills in the form of chips. The veneer cores, being easily handled in round form, are sold to pulpmills where they are chipped in the mill chippers.

The sawmill waste used by sulfite mills in the Pacific Northwest in 1951 amounted to about 5 percent of their total wood supply.[4] Approximately 1-1/4 million air-dry tons of sulfite pulp were produced; the amount of pulp derived from sawmill waste was estimated at 60,000 air-dry tons.

A considerable tonnage of kraft pulp is being produced from sawmill waste in the form of slabs and edgings, which is unsuited for lumber because of low grade or decay, and the residue from plywood plants. This material is either chipped at the wood mill and sold to the pulpmill as chips or is transported to the pulpmill in whole form where it is chipped in special chippers and made into pulp for use in bag stock, toweling, and kraft specialty papers. In 1952,[5] sulfate mills in the Pacific Northwest replaced much of their log and pulpwood requirements by chips from mill residues that would otherwise have been burned.

In utilizing slabs and edgings for chemical pulps, the amount of bark present affects the type of pulp and the end product for which the waste material can be used. For the production of clean light-colored pulps by the sulfite process, a very little bark is objectionable. For the production of kraft pulp to be used in container board and cheap wrappings, where cleanliness of the pulp is not of major importance, considerable bark can be tolerated.

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[3] Hill, E. H. Substitutes for Round Pine Wood in Making Alkaline Pulps. Paper Trade J. Vol. 119, No. 19, pp. 185-187. 1944.

[4] Hammond, R. N. The Utilization of Wood Waste in the Manufacturing of Chemical Pulps in the Pacific Northwest. Forest Products Res. Soc. Proc. Vol. 5, pp. 150-154. 1951.

[5] Pacific Northwest Forest and Range Experiment Station. Annual Report - 1952, pp. 9-10.

In sulfate pulping tests at the Forest Products Laboratory[6] on kraft-type, bleaching sulfate, and sulfate semichemical pulps, the presence of bark caused (1) an increased in yield of pulp from a cord of rough pulpwood, (2) an increased in consumption of active chemicals during cooking, and (3) a decrease in brightness of the pulp, or darker-colored pulps. Over a range of 0 to 25 percent bark, the active alkali required per ton of pulp is directly related to the percentage of bark, and increases at the rate of 13.4 pounds of active alkali for each 1 percent of bark.[7]

## Semichemical Pulp

Semichemical pulping can be broadly defined as a two-stage pulping process involving chemical treatment to remove part of the lignocellulose fiber-bonding material and mechanical refining to complete the pulping action. This process has been found particularly well suited to the pulping of certain litte-used hardwoods, often termed "waste woods," although excellent pulps have also been made from softwoods.

As the result of work at the Forest Products Laboratory some 20 years ago, the first application of the semichemical process to the production of corrugating boards from extracted chestnut chips has developed into an industry which supplies a considerable tonnage of this material today. Large quantities of semichemical pulps from other species are used for insulating board and container board.

Experiments at the Forest Products Laboratory[8] have shown that oak slabs containing as much as 20 percent of bark can be used for the manufacture of corrugating board through the semichemical process. Other forms of wood waste are also used in making this product in one or two commercial operations. With some woods a considerable amount of bark can be tolerated and with others, very little reduces pulp quality.

## Groundwood Pulp

Groundwood pulp made from veneer cores, wood-mill slashings, bolts of solid wood that are unsuitable for lumber, and from presteamed Douglas-fir slab wood is used in the manufacture of corrugating board, bags, and toweling paper.[9]

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[6] Martin, J. S., and Brown, K. J. Effect of Bark on Yield and Quality of Sulphate Pulp from Southern Pine. Tappi Vol. 35, No. 1, pp. 7-10, 1952.

[7] Allo, G. F. Review of Alkaline Pulping Procedures in Canadian Mills. Pulp and Paper Ind. Vol. 20, No. 2, pp. 62-63. 1946.

[8] Keller, E. L. Effect of Bark in the Neutral Sulfite Semichemical Pulping of Aspen, Hickory, and Slash Pine. Tappi Vol. 33, No. 11, pp. 556-560. 1950.

[9] Anonymous. Waste Wood -- a Challenge that Built the Longview Fibre Company. Pacific Pulp and Paper Ind. Vol. 15, No. 3, p. 10. 1941.

## Roofing Felt

There is considerable demand at present for coarse fibers for use in roofing and saturating felts. Roofing felt mills procure their wood in several forms: logs, mill waste, chips, and coarse fiber. Where it is obtained as log and mill waste, it is first reduced to chips, then reduced to coarse fiber in an Asplund Defibrator. When received in chip form, the wood goes directly to the fiberizing machine. Although Asplund fiber can be pressed to remove free water and be baled for shipment in a damp condition, it is not known that this is being done at present. The fiber is ordinarily used in the felt mill where it is produced.

Several plants in this country supply to roofing felt mills in their vicinity a coarsely fiberized wood product, which is produced by a dry shredding process.

Among manufacturers of machines adaptable to the manufacture of coarsely fiberized wood are:[10]

Allis-Chalmers Mfg. Co., West Allis, Wis.
American Defibrator, Inc., Chrysler Bldg., New York, N. Y.
Bauer Bros Co., Springfield, Ohio
Pandia, Inc., 122 E. Forty-second St., New York, N. Y.
Sprout-Waldron and Co., Muncy, Pa.
Sutherland Refiner Corp., Trenton, N. J.

Fine sawdust (6 to 8 mesh) is finding some use in saturating felts where it acts as a filler and probably increases the absorptive power of the felt for asphalt.

For making these fibers, it is said to be desirable that the wood waste be in a green or moist condition rather than dry. Some manufacturers claim that the fiber obtained from air-dry wood causes the felt to be brittle and weak.

## Insulating Board and Structural Board

Wood waste has assumed importance in the production of insulating board and hardboards. Low-density softwoods and hardwoods are mostly used. With new developments in fiber processing equipment, the denser types of hardwoods will probably come into greater use. The wood wastes used consist of cull sawlogs and pulpwood logs, slabs and edgings, byproduct chips from naval stores extraction, and pulpmill screenings. In addition to wood, several agricultural waste materials and waste paper are used in the manufacture of some wall boards.

A modern insulating-board plant usually requires from 150 to 200 cords of wood per day and costs from 2 to 3 million dollars. The output of such a mill will be from 400 to 500 thousand square feet of 1/2-inch board per day.

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[10] Inclusion of names in this list, which is undoubtedly incomplete, implies no endorsement as to quality or prices.

Sawmill waste in the form of chips is being supplied to several insulating-board mills as raw material for insulating-board stock. In some instances wood chips are steamed or given a mild digestion for a short time in a digester and then passed through refiners. Asplund pulp is also used for insulating board.

Processed raw wood offers possibilities as a cheap component of insulating board or hardboard. The waste in the form of slabs, edgings, or round wood can be fiberized, or chips or hogged wood can be passed through a disk refiner without any previous treatment other than wetting with water. Although fibers produced directly by these methods may have low strength characteristics, they are suitable as fillers for boards where strength is of secondary importance. One advantage of this type of material is that wood wastes can be fiberized in small quantities, baled, and shipped to mills for conversion into boards.

Work at the Forest Products Laboratory[11] has shown that pulps suitable for insulating board and hardboard can be made from slabs, edgings, planer ends, and hogged veneer of western hemlock, Douglas-fir, or white fir. The waste was chipped, steamed mildly to soften the chips, and fiberized in a disk refiner.

In 1952, ten hardboard plants in operation or under construction in Oregon and Washington, with a rated capacity of approximately 450 million square feet of 1/8-inch board per year, based their production on a raw material supply otherwise wasted.[12] One plant will operate on cull white fir timber, while the rest will use either sawmill or plywood residues.

A satisfactory insulating board can be made from wood-mill sawdust held together with a binder of highly beaten wood pulp.[13] Following methods described in United States patents issued to Howard Weiss in 1927, boards were made at the Forest Products Laboratory containing as much as 85 percent sawdust previously processed in an attrition mill, and 15 percent hydrated pulp. Since these boards were hand made on a small scale, no major difficulties were encountered in their formation, pressing, and drying. Because of the low drainage and felting properties of this type of material, these mixtures might not run well on conventional continuous board machines but probably would be suitable for small-scale batch operations.

Although the effect of heat-treating structural board (hardboard) to increase its breaking strength has been recognized for many years, it is only recently that it has been applied in general practice.[14] In this treatment the board is carried from the press and held for 4 to 5 hours in a chamber heated at

[11] Schwartz, S. L., Pew, J. C., and Schafer, E. R. Production of Insulating Board and Hardboard from Sawmill and Logging Waste. Abstract in Paper Trade J. Vol. 124, No. 8, p. 36. 1947.

[12] Pacific Northwest Forest and Range Experiment Station. Annual Report - 1952, pp. 9-10.

[13] U. S. Forest Products Laboratory. Insulating Boards from Mill Wastes, Forest Thinnings, and Cull Trees. Forest Products Laboratory Report No. R1762, 15 pp. 1950.

[14] Lowgren, Uno. Wallboard Manufacture in Sweden by the Defibrator System. Pulp and Paper Ind. Vol. 21, No. 1, p. 50. 1946.

120° to 140° C. It is then passed through a section with circulating moist air to stabilize it for atmospheric conditions. The heat treatment usually increases the modulus of rupture about 25 to 30 percent, but at the same time increases the brittleness. With prolonged heat treatment, the modulus of rupture increases to a maximum, after which it drops rapidly. The rate of increase and drop in strength increases as the temperature increases. Hardboard can also be made by a dry-forming process. The pulp, instead of being carried as a water suspension onto a screen for formation, can be formed in a dry or semidry condition and hot pressed into a board which is usually given an additional heat treatment. The properties of the board are greatly influenced by additives such as waxes and resins.

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In preliminary work at the Forest Products Laboratory, several structural boards were made by dry-forming mixtures of sawdust with rosin and coal-tar pitch. Although the strength of these boards was below that required by Federal Specification LLL-F-311 for a Class A hard-pressed fiberboard, the product had a resistance to abrasion equal to that of oak wood, which might make it suitable for molded tiles to be used as a prefinished floor covering.

## Corrugating Board

Since strength and color can be quite variable in a satisfactory corrugating board, this type of product forms a ready outlet for wood wastes. As mentioned previously, kraft and semichemical pulps from wastes are being used for large tonnages of corrugating board.

Current experiments at the Forest Products Laboratory indicate that furniture-mill waste, mostly hardwoods, can be made into a product comparing favorably with commercial corrugating board by converting the waste into a semichemical pulp and processing it in a disk refiner.

## Boxboard

It is reported[15] that a satisfactory fiber for conversion into boxboard and coarse papers was prepared from wood waste, shavings, and sawdust by treatment in an Asplund Defibrator-Chemipulper followed by refining in a stone-roll beater.

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[15] Church, J. W. Fibre from Waste Wood. Pulp & Paper Mag. Can. Vol. 47, No. 3, p. 275. 1946.